

DIVISION 16 – ELECTRICAL

SECTION 16700

ELECTRICAL CONTROLS

PART 1 - GENERAL

1.1 GENERAL

- A. This section of the specifications shall govern the construction and operation of the pump automatic control systems.

1.2 DESCRIPTION

- A. Description of the Systems: The Contractor shall furnish, install, calibrate, test, paint and place in satisfactory operating condition all controls, related instruments, appurtenant equipment, piping and accessories as indicated on the drawings and as described hereinafter for two pump control panels as follows:
1. One panel shall be for the leachate effluent pump station and shall be a float controlled duplex pump down level control system. The panel shall be configured for 277/480 volt three phase service and shall house a main disconnect plus disconnects for each circuit pump and other devices in accordance with the NEC. The panel shall contain a minimum 1 KVA 120/240 volt step down transformer and provide 120 volt branch circuit breakers for the following:
 - Pump controls
 - Flow Meter
 - Pipe Heat Tracing
 - General Purpose Receptacle
 2. The second control panel shall be for the air stripper pumping station. This pumping station shall be a duplex (two pump) station, but shall only operate a single pump at one time. This panel shall be configured for 120/208 volt three phase service and shall house a main disconnect, disconnects for each pump, and a control circuit disconnect. The control circuit shall be fused to allow circuit extension beyond the panel and to provide power to operate two remote electrically actuated ball valves.
 3. In addition to the two pump station control panels, the Contractor shall provide level transducers with associated level readout devices for the existing T-1 and T-2 leachate tanks.

B. Related Work Described Elsewhere

1. All conduit and wiring between all units, power sources and panel shall be furnished and installed under Section 16050 of these specifications.

1.3 STANDARDIZATION

- A. It is the intent of these specifications that all pump control systems shall utilize controllers specifically designed for pump level control applications. The use of general purpose controllers requiring special programming aides such as laptop computers, programming environmental software, etc. is prohibited unless all this additional material is provided to the owner as part of the work.

1.4 RESPONSIBILITY AND COORDINATION

- A. The Contractor's attention is directed to the fact that this is an integrated system, and as such, shall be furnished by one supplier who shall provide all of the equipment and appurtenances--regardless of manufacture--and be responsible to the Contractor for satisfactory operation of the entire system.
- B. The Contractor shall coordinate the work of the system manufacturer's service personnel during construction, testing, calibration and acceptance of the equipment.
- C. It shall be the responsibility of the Contractor to furnish a complete and fully operating system. The Contractor shall be responsible for all details which may be necessary to properly install, adjust, and place in operation the complete installation.

1.5 ADDITIONAL REQUIREMENTS

- A. Any specialized tools required for maintenance and routine repairs shall be furnished.
- B. Spares as follows:
1. Twenty-five percent spare fuses and lamps for each type used including line protection unit fuses. A minimum of 3 of each type.
 2. Two spare of each type of relay used.
 3. Four spare level float switches.

1.6 SUBMITTALS

A. Shop Drawings or Data

1. Specification Check Sheets
2. Dimensions, drawings, wiring, and/or piping drawings for field mounted equipment.
3. Equipment specification sheets.
4. Where panels are to be furnished, fabrication and nameplate legend drawings, internal wiring drawings.
5. System schematic drawings illustrating all components being applied, complete with electrical interconnections.
6. Wiring diagrams shall be furnished for all control panels and shall be encased in plastic or plexiglass envelopes. These diagrams shall represent the "as-built" circuitry and shall include all equipment and shall show connections from numbered terminal blocks to external equipment. Color coding and relay terminal numbers shall be indicated. At the Contractor's option, these drawings may be photographically reduced to facilitate placement and encasement.

B. Operating and Maintenance Instructions

PART 2 - PRODUCTS

2.1 LEVEL SENSORS

A. Signal Converter :

A 4-20 mA transmitter shall be provided to convert the sensed process variable from a nominal 0-5 VDC to 4-20 mA. The transmitter shall be 2 wire, 12 to 40 VDC loop-powered with its output proportional to the sensor input. The transmitter shall be UL Listed.

The transmitter shall provide easily accessible calibration and ranging adjustments. Offset shall be adjustable from 10-100% and Span shall be adjustable from 10-100% of the 5 Volt range.

The transmitter shall contain integral level simulation for ranging adjustments and system test purposes. The transmitter shall provide adjustable signal damping time constants of 0.1, 2 and 5 seconds.

The transmitter shall provide three levels of transient protection on the 4-20 mA loop: a gas tube arrestor for suppression of high voltages, transorbs, and varistors for fast clamping of lower voltage transients. The transmitter's output shall be measurable without disconnecting the loop power. Each transmitter shall be provided with a power supply, digital readout, and a dry contact meter relay to signal high level. Transmitters for the T-1 and T-2 tanks shall be individually mounted in a NEMA 4 enclosure with the readout visible through the cover. The transmitter shall be a CONTEGRA Model T420.

B. Transducers:

A submersible level transducer shall be provided to sense the liquid level at the location as shown on the plan drawings and in accordance with the manufacturer's recommendations.

The transducer housing shall be fabricated of PVC with a 2.5" diameter Teflon[®] diaphragm. Silicone oil shall be used as a hydraulic fill.

The sensor shall provide an output signal directly proportional to the sensed pressure. The sensor shall be mounted using its signal cable and have 3/4" NPT pipe threading for pipe mounting.

The internal air pressure of the sensor assembly shall be relieved to atmospheric pressure through a sealed breather system.

The transmitter shall contain easily accessible calibration and ranging adjustments. Offset shall be adjustable from 0-90% of the sensor range. Span shall be adjustable from 10-100% of the sensor range. The transmitter shall contain integral level simulation for ranging adjustments and system test purposes. The transmitter shall provide adjustable signal damping.

The sensor shall be mounted using its signal cable and have 3/4" NPT pipe threading for pipe mounting.

The transmitter shall be a 4-20 mADC, 2 wire, 10-30 VDC loop-powered type, with its output signal directly proportional to the measured level excursion. The sensor shall be UL 913 approved intrinsically safe. The transducer shall be a CONTEGRA Model SLX 130-MIS.

2.2 PUMP ALTERNATOR

- A. Provide an alternating controller to alternate the pumps in a lead- lag(leachate pump station) or a 1-2(air stripper pump station), start stop sequence. The alternator shall be a microprocessor based controller designed for use where two loads are required to alternate to provide equal run time on the loads.

LED indicators show the status of the unit's three control switch inputs and 2 load outputs. A lead select switch allows the loads to alternate normally in the center position, or disable automatic sequencing and lock in a 1-2 or 2-1 sequence.

When a Stop, Lead or Lag switch closes, the corresponding LED on top of the unit will illuminate. When the Stop switch and Lead switch closes, Load 1 or Load 2 will come on and the corresponding green LED will illuminate. At the leachate pump station, if fluid levels continue to rise and the Lag switch closes, the 2nd load will energize. At the stripper pumping station, on a rise in fluid levels to the high water float, the input logic to the alternator shall cause the alternator to switch to the other pump without starting both pumps. Loads remain energized until the Stop switch opens or a fault condition is detected.

In lieu of a separate alternator, the pump controller may be used to provide the alternating function if this is an integral part of the controller.

B. Fault Detection

If any control switches open or close out of order, the faulty switch is by passed by the fault detection logic. STOP, LEAD and LAG switch inputs are reassigned to maintain safe operation. Should a faulty or fouled switch begin operating normally, the fault detection logic will restore STOP, LEAD and LAG assignments to their proper designation.

The alternator shall be a Time Mark Model 2611 or equal.

2.3 MOTOR STARTERS (Leachate Pump Station)

- A. Motor starters shall be in accordance with Specification Section 16050 and shall be Nema rated.

2.4 ADJUSTABLE FREQUENCY MOTOR CONTROLLERS (Air Stripper Pump Station)

- A. Description
1. The AC Drive shall convert the input AC mains power to an adjustable frequency and voltage.
 2. The input power section shall utilize a full wave bridge design incorporating diode rectifiers. The diode rectifiers shall convert fixed voltage and frequency,

AC line power to fixed DC voltage.

3. The output power section shall change fixed DC voltage to adjustable frequency AC voltage.
4. The adjustable frequency drive package shall include input EMI/RFI filtering.
5. The AC drive shall have a user interface (keypad) that presents information in plain English text. The user interface shall include a Local / Remote button to switch between control at the terminal strip and the user interface (keypad). This button shall also switch between network control and the user interface (keypad). The keypad shall have a manual speed potentiometer function.

B. Construction

1. All heat sink fans shall be accessible from the front and shall not require the removal of the AC drive power converter for fan replacement.
2. All heat sink fans shall be cycled on only when required to cool the drive to maximize the life of the fan
3. The AC Drive shall be suitable for mounting in the pump control enclosure.

C. Application Data

1. The AC Drive shall be sized to operate a variable torque pump load.
2. The speed range shall be from a minimum speed of 1.0 Hz to a maximum speed of 72 Hz.

D. Environmental Ratings

1. The AC Drive shall meet IEC 60664-1 Annex A and NEMA ICS 1, UL, and CSA standards.
2. The AC Drive shall be designed to operate in an ambient temperature from -10 to 50 °C (14 to 122 °F).
3. The maximum relative humidity shall be 95%, non-condensing.
4. The AC Drive shall be rated to operate at altitudes less than or equal to 3300 ft (1000 m).
5. The AC Drive shall meet the IEC 60721-3-3-3M3 operational vibration specification.

E. Ratings

1. The AC Drive shall be designed to operate at the input line voltage indicated.
2. The AC Drive shall operate from an input frequency range of 60 Hz (\pm) 5%.
3. The displacement power factor shall not be less than .98 lagging under any speed or load condition.
4. The efficiency of the AC Drive at 100% speed and load shall not be less than 97%.
5. The variable torque rated AC Drive over current capacity shall be not less than 110% for 1 minute.
6. The output carrier frequency shall be randomly modulated about the selected frequency. The output carrier frequency of the AC Drive shall be selectable

from 1 to 16 kHz.

F. Protection

1. Upon power-up, the AC Drive shall automatically test for valid operation of memory, loss of analog reference input, loss of communication, DC-to-DC power supply, control power and pre-charge circuit.
2. The AC drive shall be rated for UL minimum short circuit currents per given horsepower rating.
3. The AC Drive shall be protected against short circuits, between output phases and to ground.
4. The AC Drive shall have under-voltage power-loss ride through performance per the SEMI F-47 voltage ride through standard and certified by a third party.
5. The AC drive shall have a programmable ride-through function, which will allow the logic to maintain control for a minimum of one-second (60 cycles) without faulting.
6. An auto restart function will provide selectable time for restart attempts after the fault has disappeared and other operating conditions permit the restart. The restart shall be performed by a series of automatic attempts separated by increasingly longer periods of time. This period of time shall be selectable.
7. The AC Drive shall have a solid-state UL 508C listed overload protective device.
8. The output frequency shall be software enabled to fold back when the motor is overloaded.
9. There shall be three skip frequency ranges that can be programmed to a bandwidth of 2.5 Hz.

G. Adjustments & Configurations

1. The AC Drive shall be capable of storing the configuration in the keypad.
2. The acceleration and deceleration ramp times shall be adjustable from 0.05 to 999.9 seconds.
3. The memory shall retain and record run status and fault type of the past eight faults.
4. The AC Drive shall have macro configurations for pump applications, PID regulator set-up and network set-up.

H. Keypad Display Interface

1. A keypad display interface shall offer the modification of AC Drive adjustments through a touch keypad. All electrical values, configuration parameters, I/O assignments, application and activity function access, faults, local control, and adjustment storage, and diagnostics shall be accessible.
2. The AC Drive model number, torque type, software revision number, horsepower, output current, motor frequency and motor voltage shall be listed on the drive identification portion of the LCD display.
3. The keypad display shall have password protection that allows the keypad to

be locked out from unauthorized personnel.

4. The keypad shall be capable of displaying I/O assignment and status.

I. Control Connections

1. The control power for the digital inputs and outputs shall be 24Vdc.
2. The internal power supply shall incorporate automatic current fold-back that protects the internal power supply if incorrectly connected or shorted. The transistor logic outputs will be current limited and will not be damaged if shorted.
3. Removable terminal strips shall be used on all logic and analog signal connections in the power converter
4. Two voltage-free relay output contacts will be provided. One of the contacts will indicate AC Drive fault status. The other contact shall indicate a drive run status. These relays shall be configurable for other status indicators.
5. The AC drive shall have a power removal logic input. The drive shall not allow the motor to operate until this input is closed. If this input is opened while the connected motor is running, the AC drive shall stop applying power to the motor. This power removal function shall be certified by an independent agency.
6. The control section of AC drive shall be supplied separately if necessary with 24V DC, to keep the network communication always available even if the power supply is OFF.

2.5 AUXILIARY CONTROL

- A. Auxiliary control relays to perform the interlocking sequential and general control functions shall be for operation on 120 volts, 60 cycles, with contacts rated 10 amperes at 120 volts AC, and shall be equipped with the number of normally opened and normally closed contacts required. Control relays shall be plug-in type with indicator light.
- B. Auxiliary timers shall be of the multi-range solid state type with relay output designed for industrial service. Each timer shall have a choice of 16 switch selectable ranges between 0.05 seconds and 100 hours. Within each range the timer shall have a dial adjustable to any desired timing. Each timer shall have a four mode capability for use in the on-delay, off-delay, repeat cycle, or flasher mode depending on how the timer is wired. In addition, each timer shall have a LED annunciator light to indicate timing cycle progress.
- C. Indicating lights, selector switches, and pushbutton shall be 600 volt, heavy-duty, oil-tight type and shall be semi-flush mounted on the unit doors.
- D. Pilot lights shall be transformer type or LED for longer lamp life. They shall be provided with lenses and functional nameplates as required. All pilot lights shall be

push-to-test type.

- E. All wires shall be identified at both ends by wire labels and all wire numbers shall appear on drawings. No two wires shall have the same number.
- F. Annunciation

Provide pilot lights to annunciate the following functions and provide double throw 10 amp dry contacts connected to the SCADA RTU for the functions indicated by (*). Those noted by (**) shall also provide an output to the alarm dialing communicator.

Leachate Pump Station

1. Pump 1 run – monitor motor starter.(*)
2. Pump 2 run – monitor motor starter. (*)
3. Pump 1 fail – monitor motor starter overloads. (**) Common with 4. to dialer.
4. Pump 2 fail – monitor motor starter overloads. (**) Common with 3. to dialer.
5. High wet well – monitor controller. (**)
6. Low heat trace pipe temperature – monitor freeze thermostat.(**)
7. Loss of phase. (*)

Air Stripper Pump Station

8. Pump 1 run – monitor motor starter.(*)
9. Pump 2 run – monitor motor starter. (*)
10. Pump 1 fail – monitor motor starter overloads. (**) Common with 11. to dialer.
11. Pump 2 fail – monitor motor starter overloads. (**)Common with 10. to dialer.
12. High wet well – monitor controller. (**)
13. Loss of Phase. (*)

Provide a common pushbutton lamp test switch.

2.6 ALARM DIALER

- A. Modify the existing Antx Dialog Elite alarm communicator to add the following functions.

1. Two 8 channel digital input cards. These shall be connected to the SCADA RTU to provide the alarms as noted on the plans.

2.7 HIGH WATER ALARM

- A. Provide a remote high water alarm strobe light located on a conduit stem above the control panel shelter roof. This alarm shall be common to both pump station control panels.

2.8 TIME CLOCK

- A. In the Air Stripper Pump Station control panel, provide a time clock to operate the lead pump. As long as the pump transducer indicates level, this time clock can override the lead pump start level signal and cause the lead pump to start and operate until the pump stop level is reached. The clock shall be provided in conjunction with an adjustable 1-999 second normally closed-timed closed delay relay to prevent the clock restarting the pump without a sufficient motor cool down period. The time clock shall be a general purpose digital type with 365 day programming equal to Tork Model D2200A.

2.9 INTERLOCKS AND ADDED SCADA INTERFACE

- A. Provide interlocks in the air stripper pump station control panel to allow operation of the new pump station or the existing T-1 stripper pump. Also, provide interlocks in the air stripper pump station to operate the existing chemical feed pumps and air blower. These controls are located in the existing T-1 pump control panel.
- B. Provide a 4-20ma loop connection from the existing Precision Digital T-3 tank level indicator in the alarm dialer cabinet and terminate it on the analog terminal strip in the new SCADA Terminal Panel. Extend a 2 conductor, 18awg shielded cable in 3/4" conduit from the dialer cabinet to the SCADA Terminal Panel.

2.10 PANEL CONSTRUCTION

A. Enclosures

- 1. Unless indicated otherwise, panel enclosures shall be NEMA 12 construction, wall mounted, with enclosure heater to prevent condensation. Dimensions shall be as required.
- 2. The panel, including frame components, shall be bonderized and sprayed with two base coats after fabrication for panels located inside. Exterior finish shall be a high grade enamel of a color to be selected by the owner from color charts provided by the panel manufacturer. The interior shall be finished with a high grade white enamel. An extra pint of touch-up paint shall be provided for the exterior finish color furnished.

B. Mounting of Components

- 1. Components shall be mounted to provide mechanical clearances sufficient for mounting, wiring, adjustment, testing and replacement. Each component shall be mounted to provide heat dissipation consistent with the temperature rating of the

component, adjacent components and conductors. Each component shall be arranged and oriented so that the identification may be determined without moving the component or its wiring.

2. Equipment shall be mounted so that any component or component part can be replaced without removing the sub-plate. No components shall be mounted behind door pillars unless adequate space is provided for replacement and servicing. In no case shall any control component be mounted directly above or behind the disconnecting means.
 3. Control components shall be front mounted on a rigid metal subplate so that the complete subplate can be removed through the enclosure opening. Subplate metal shall be a minimum of 0.106 inches (MGS No. 12) nominal for mounting components with one-quarter inch diameter screws or smaller. Where larger screws are required, additional reinforcement or heavier gage subplates shall be provided. All mounting screws shall have the NF or NC threads.
 4. Any component(s) mounted on the subplate carrying line voltage to a combination of line voltage and control voltage shall be grouped above or to the side and segregated from devices which carry only the control voltage. This does not apply where the line voltage is 120 volts.
 5. To minimize electromagnetic interference, solid state control and its associated wiring shall be segregated from the electromagnetic control wiring.
 6. Back panel mounted control components, such as relays, starters and contactor shall be mounted in numerical order from left to right and top to bottom.
 7. Terminal blocks shall be mounted to provide an unobstructed access to terminals and their conductors. The blocks shall not be mounted above each other in a plane perpendicular to the subplate. Terminal strips shall not be mounted in wireways.
 8. Segregated terminal strips shall be used for power and control circuits.
- C. Disconnecting Means: Furnish molded case circuit breakers conforming to the requirements of NEMA.
- D. Nameplates: Nameplates for door mounted items shall be manufacturer's standard for push buttons and selector switches. Others shall be laminated engraving stock 0.062 inches thick minimum. All tags shall be black with white letters unless otherwise specified.

Exception: Warning tags shall be yellow with black letters.

Nameplates for the interior mounted devices (both sub-plate items and back side of the door) shall be mounted with embossed vinyl tape. Particular attention shall be paid to ensuring that this tape is properly adhered to the panel.

Nameplate showing the following shall be provided:

Manufacturer
Job Name
Job #:
Built By:
Inspected By:
Date:
Warranty Expires:

E. Conductors

1. The minimum size for power conductors shall be the minimum permitted by the National Electric Code. Sizes smaller than #14 AWG will not be permitted.
Power wire shall be THW unless environmental conditions require another type.
2. Control wire shall be MTW or as an alternate type THWN, THHN, RHH having all characteristics equal to type MTW except insulation thickness. #16 AWG for control - #22 AWG for electronic and static devices.
3. Conductors shall be color-coded as follows:

Black - Line and load circuits, ac or dc.
Red - ac control circuits, 150 volts and lower.
Blue - dc control circuits, 150 volts and lower.
Yellow - All control circuits or wiring which may remain energized when the main connecting means is in the off position.
Green - Equipment grounding conductors - non-current carrying.
White - Grounded - current carrying - circuit conductors.
Exception - Coil and component leads.
4. Instrument conductors (4-20 ma) shall be #18 AWG stranded, shielded with outer insulation.

F. Wiring Methods and Practices

1. Conductor Identification: Conductors shall be identified at each end with slip on wire markers with a marking corresponding to the wiring diagrams. Slip on markers shall be of the type that will not fall off the conductor if the conductor is removed from its termination. Adhesive wire markers may be used for "type on" or printed markings.
2. Terminals: Terminals shall be plainly and permanently marked to correspond with the wire identification shown on the documentation.

Terminal blocks shall be wired and mounted so that internal and external wiring does not cross over the terminals. Terminal blocks shall be provided for all control conductors requiring connection to external devices.

3. Electrical Connections: Conductors shall be run without splices from terminal to terminal. Spade type lugs shall be used when terminals do not have provisions for accepting bare wire.

Plug and receptacle shall be installed to supply 115V ac power to instruments.

Shields on shielded wire shall be grounded only at the terminal strip at a single ground point.

4. Control Panel Enclosure Wiring: All wiring shall be contained in wiring duct or in neat wiring trees harnessed with nylon wire wraps.

The wires in wire harnesses shall run parallel and not cross over each other. Sufficient slack shall be provided at hinge points to prohibit abrasion or strain on the terminations.

A terminal block shall be provided for all external control wiring.

Wiring duct shall be sized so that it is not filled beyond 50 percent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment in accordance with the manufacturer's instructions.

3.2 START-UP

- A. Start-Up and Commission Systems: Allow sufficient time for start-up and commissioning prior to placing control systems in permanent operation.

- B. Provide service engineer to instruct Owner's representative in operation of systems plant and equipment for a 2-day period.

Demonstrate complete and operating system to Owner.

3.3 PUMP CONTROL SEQUENCE OF OPERATION- LEACHATE PUMP STATION-

A. Sequence, Duplex Pump Control

1. With the selector switches in hand position, the pumps shall start and stop in response to the switches.
2. With the selector switches in the automatic position, the pumps shall operate in response to the controller as directed by the state or the setting of the duplex alternator. In the automatic position, the SCADA system shall provide a set of dry contacts located in parallel with the automatic function lead pump and lag pump contacts. Either the automatic or SCADA contact set can start a pump, but both must open to stop the pump.

On a rise in level, the lead pump shall start.

On a further rise in level, the lag pump shall start.

Both shall run until the level drops to the pump stop elevation.

On a further rise in level, a high water alarm light in the panel and the exterior high water alarm light shall illuminate and lock-in until manually reset.

3.4 PUMP CONTROL SEQUENCE OF OPERATION- AIR STRIPPER PUMP STATION-

A. Sequence

1. The control panel will operate two pumps with the pumps interlocked so that only a single pump can operate at any time. The operating frequency in HZ of each pump shall be manually selected at the pump's adjustable frequency drive.
2. Provide a master selector switch in the existing T-1 Pump Control Panel that will allow selection of the Air Stripper Pump Station or the existing T-1 pump. Provide a Pump-1, Pump-2, Both switch in the Air Stripper Pump Station Control panel and a Hand-Off-Automatic switch for each pump to be used in conjunction with the Pump-1, Pump-2, Auto switch.
3. With the master selector switch in the Air Stripper Pump position, the pump selector switch in the Both position, and each pump switch in the Auto position,

the air stripper pumps shall operate in response to the setting of the level controller and the automatic duplex alternator. When the fluid level reaches the lead pump start switch the lead pump shall start and operate until the fluid level drops to the stop level. Also, in this position, the time clock will be able to start the lead pump. See paragraph 2.8 above.

4. If the fluid level continues to rise above the lead pump start level to the high water level, the pump control logic shall shut down the lead pump and select the remaining pump for operation. The logic shall also transmit a high water alarm and operate the high water alarm light.
5. With the master selector switch in the Air Stripper Pump position, the pump selector switch in the Pump-1 position, and each pump switch in the Hand or Auto position, only pump 1 shall operate. It shall operate manually if selected by the Hand position, or in response to the level controller if the pump control selector is in Auto. The alternator is bypassed.
6. Similarly, with the master selector switch in the Air Stripper Pump position, the pump selector switch in the Pump-2 position, and each pump switch in the Hand or Auto position, only pump 2 shall operate. It shall operate manually if selected by the Hand position, or in response to the level controller if the pump control selector is in Auto. The alternator is bypassed.
7. The Hand selector switch position on each pump controller will be disconnected in the Both position of the pump selector switch. Only, the off or Auto will function.
8. With the master selector switch in the T-1 Pump position, the T-1 pump shall operate in response to its controls and the Air Stripper Pump Station will be inoperative.
9. When either of the two Air Stripper Pumps operate its discharge ball valve will be motored open and the other pump valve will be driven closed. When both pumps are off, both discharge ball valves shall be kept open for freeze protection drainage.
10. Interlocks shall be provided between the Air Stripper Pump controls and the existing relay logic T-1 pump controls so that the existing air stripping tower blower, and the chemical feed pumps will operate any time one of the Air Stripper Pumps operates

END OF SECTION